



# FAULT DETECTION AND ISOLATION IN INDUSTRIAL PRODUCTS USING IMAGE PROCESSING

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**Abstract:** Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. Some of the major fields in which image processing is widely used are Image Sharpening and restoration, Medical field, video processing. Image processing is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Fault Detection and Isolation (FDI) is essential in industry to detect and isolate objects with manufacturing defect. Manual inspection is time consuming and all the features of the components cannot be verified accurately. Hence, there is a need for an image processing based system to detect the anomalies in the components. Components are detected by using camera and the captured image are pre-processed to remove background noise, then image is enhanced to get the appropriate features by KNN algorithm. The KNN algorithm is more efficiency than the existing SVM algorithm and Region of Interest is extracted to measure the diameter.

**Keywords:** Fault Detection and Isolation, Image processing, KNN algorithm.

## I. INTRODUCTION

Image processing is any form of processing for which the input is an image or a series of images or videos, such as photographs or frames of video. The output of image processing can be either an image or a set of characteristics or parameters related to the image. It also means "Analysing and manipulating images with a computer Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

### Types of Image Processing

There are two types of methods used for image processing namely

1. Analogue Image Processing
2. Digital Image Processing

**Analogue Image Processing:** Analogue image processing can be used for the hard copies like printouts and photography. Image analysts use various fundamentals of interpretation while using these visual techniques.

**Digital Image Processing:** Digital Image Processing (DIP) is a software which is used to manipulate the digital images by the use of computer system. It is also used to enhance the images, to get some important information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image.

Digital image processing techniques help in manipulation of the digital image by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing enhancement, card display information extraction.

Digital image processing consists of the manipulation of images using digital computers. Its use has been increasing exponentially in the last decades. Its applications range from medicine to entertainment, passing by geological



processing and remote sensing. Multimedia systems, one of the pillars of the modern information society, rely heavily on digital image processing. Some of the major fields in which digital image processing is widely used are mentioned below:

Image sharpening and restoration, Medical field, Remote sensing, Transmission and encoding, Machine/Robot vision, Colour processing, Pattern recognition, Video processing, Microscopic Imaging.

### 1.1 OBJECTIVE

To develop an image processing-based solution which identifies the faulty components and isolate to measure quality parameters. To reduce time consumption for the detection of damage and to reduce the manual workload.

### 1.2 SCOPE

By using this project, we are able to find the faulty component, were this early detection of process can also help to avoid abnormal event progression and this process can also be used in the smart manufacturing industry, image recognition, robot vision and video processing.

## II. ANALYSIS

### 2.1 SYSTEM ANALYSIS

System Analysis is a combined process dissection the system responsibilities that are based on problem domain characteristics and user requirement.

#### 2.1.1 Problem Definition

The Quality Control for automated sensitive product manufacturing is one of the important aspects in almost all industries nowadays. Automated monitoring of the quality of the industrial products(nuts/bolt) is nowadays done using sophisticated digital image processing techniques. Corner detection and sensitive parts features extraction is gaining more popularity in quality control activities. Presently 2D edge detection algorithms are available which can aid in this task; However they have their own limitations as they are not supportive, accurate and less effective for defect detection in industrial products. So in this context, 3D image processing can improve the accuracy of detecting the defects more significantly and can be more efficient. Hence, the essence of the problem lies in how to improve the quality of the industrial products using 2D and or 3D image processing techniques. This project proposes a novel 2D/3D image processing methodology for the quality control management for sensitive industrial product.

#### 2.1.2 Existing System

Fault Detection using Image Processing approach proposed an approach to recognize fabric defects in textile industry for reducing production cost and time. Image analysis is performed on Fabric materials to detect the defect in the clothes. Image acquisition system acquires the image of the cloth and sends the image to recognizer. It converts that image into binary image by restoration and threshold techniques. Stationary wavelet transform is a technique used for the application for sorting of nuts and bolts on a conveyor belt in an industry. The optimization algorithm has few iterations than Artificial Neural Network process for the same task. The network is reduced to a certain value of the error on the sample means that the training has been completed. This value does not give us optimum results.

#### 2.1.3 Proposed system

Image processing based fault detection and isolation is proposed to detect the anomalies in the fastener (Mechanical components. nuts/bolts) sent in the conveyor belt. Here we use the Feature matching algorithm to specify a target in cluster and to remove background noise, then image is enhanced to get the appropriate features and Region of Interest (diameter of nut) is extracted to measure the diameter and it is compared with the pre-defined region of interest. If any anomaly is found in the attributes (diameter) of the mechanical components. Defected component is then carried by the secondary conveyor to the re-machining and the quality product are then carried to the packaging. In this way, components with manufacturing defect are identified and isolated from assembly line.



### III. SYSTEM DESIGN

Systems design is the process of defining the architecture, components, modules, interfaces and data for a system to satisfy specified requirements. System design is the process of defining the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system. It is meant to satisfy specific needs and requirements of a business or organization through the engineering of a coherent and well running system.

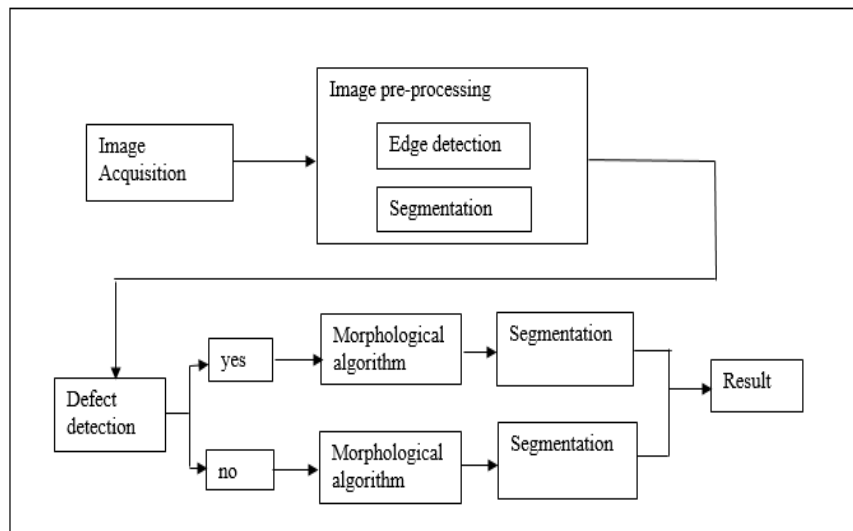


Fig 1 Overall Architecture Design for fault detection and isolation

### IV. MODULES

**Image Acquisition:** In this system the nuts and bolts were moving on the conveyor belt. The camera which is on the conveyor belt setup will capture the images of nuts and bolts. Here we use Complementary Metal Oxide Semiconductor (CMOS) Camera to capture the image in resolution of 320x240 pixels. Image acquisition is the first and most important step to capture the image. Hardware equipment carries a very important role to acquire image with sufficient contrast and sharp focusing. Each individual image was stored and further analysing can be carried on thereafter.

**Image Pre-processing:** In Image pre-processing, there are 2 main phases must be done. First is edge detection, Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Second phase is image segmentation, image segmentation is the process of partitioning a digital image into multiple segments (i.e) sets of pixels, also known as super-pixels. The goal of segmentation is to simplify and/or change the representation of an image into binary format which is more easier to analyse.

**Feature Extraction:** We have n nuts and n bolts. The nuts (and the bolts) are of varied sizes. Each bolt fits in exactly 1 nut. We would like to match the nuts with the bolts which fits into them. Since the dimensions of the nuts and the bolts are so small, we can't really tell if a nut (or a bolt) is bigger than another nut (or bolt). So the only operation that is allowed is comparing a nut and a bolt – with such a comparison we can distinguish between three cases, namely, the nut fits a larger bolt, or the nut fits a smaller bolt, or the nut fits the medium bolt. For this comparison here we use Mathematical morphology to extract the feature of the object in the Image.

**Feature matching:** From the extracted feature (inner circle) of the nut from the image, diameter is computed. If the diameter is greater or lesser than the predefined diameter, a signal is sent to embedded system. The feature matching



algorithm uses an K- Nearest Neighborhood (KNN) algorithm, it is one of the simplest of classification algorithms available for supervised learning. The idea is to search for closest match of the test data in feature space.

## V.RESULTS AND DISCUSSION

The system that has been studied has common features for almost all existing system. The existing system had performed the detection in an inefficient way when compared to the current technology. The results are extracted by measuring the efficiency of the existing and the proposed system. The detecting parameter or phenomenon of region of interest was successfully determined with high accuracy and efficiency and was inferred that it provides high efficiency and accuracy in proposed system than existing system.

## VI. CONCLUSION

In this article, the image processing technique and application of image processing expertise for automatic inspection and defect detection is discussed. Although lot of research carried by different researcher doing research in images processing, there is scope to apply image processing techniques for quality control of industrial product. The image processing techniques are very powerful tool for automatic, fast and easier defect detection and quality control of various types of products. The KNN Algorithm is proposed for real time quality monitoring than SVM for finding the faulty product in the manufactured product. This proposed system can replace manual inspection of industrial product. Result will indicate product is defective or non-defective. Using this automatic inspection system cost of inspection will be reduced also accuracy of inspection will increase than SVM.

## VII. FUTURE ENHANCEMENT

In future, There are number of future possibilities for improving the performance of KNN detection algorithms like usage of machine learning algorithms which help to identify the defective parts as these occur over a period of time. They increase their accuracy based on the updated parameter set and scenario machine algorithm like Support Vector Machine, and neural network can be used.

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